Financial and Demographic Influences on Medicare Patient Safety Events

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Abstract

Background: The hospital market is stratified between the "have" and the "have not" hospitals. Whether financial disparities among hospitals are associated with disparities in patient safety problems is unknown. **Methods:** We used the Healthcare Cost and Utilization Project (HCUP) State Inpatient Database for Florida from 1996–99 (373,814 discharges at 188 hospitals) to examine whether financial pressure at hospitals is associated with the rate of patient safety events (e.g., preventable adverse events, medical errors) among elderly Medicare fee-for-service (FFS) patients. We used the newly released Agency for Healthcare Research and Quality (AHRQ) Patient Safety Indicators (2003) and conducted regression analyses in which we controlled for the patients' risks of adverse outcomes. **Results:** We estimate that patients treated at the financially distressed hospitals are 13.7 percent more likely to have a surgery-related patient safety event than are patients treated at highly profitable hospitals ($P = 0.034$). Patients treated at the financially distressed hospitals also are 18.3 percent more likely to have a nursing-related patient safety event than are patients at highly profitable hospitals ($P = 0.001$). Furthermore, the patients treated at financially distressed hospitals are 24.1 percent more likely to die during their hospitalization than are patients treated at a highly profitable hospital ($P < 0.001$). Among the patients with potentially preventable complications ($N = 25,392$; 6.8 percent of all surgeries), those treated at financially distressed hospitals have a 26 percent higher probability of not being rescued and of dying than do patients treated at highly profitable hospitals ($P = 0.027$). We also found that women are more likely to have surgery- and nursing-related patient events than are men, while black patients are more likely to suffer surgery-related and nursing-related adverse events or death during hospitalization, compared with white patients. Hispanics are more likely to have nursing-related patient safety events, while other non-Hispanic racial minorities are more likely to have failure to rescue and to die during hospitalization, compared with whites. **Conclusions:** The finding that patients treated at financially distressed hospitals are more likely to have adverse patient safety events suggests that any cost-cutting efforts should be carefully designed and managed.

Introduction

A recent survey found that at least 10 percent of adults reported that they or a family member had experienced a mistake in a hospital or doctor's office, with more than half of the mistakes reported to be very serious.[1] The Committee on the

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Quality of Health Care in America was established in 1998 by the Institute of Medicine (IOM) to address this problem, and its first report, *To Err Is Human*, estimated that between 44,000 and 98,000 Americans die each year as a result of medical mistakes, making medical error the ninth leading cause of death in the United States.[2] Thus, this report attracted considerable attention and resulted in increased efforts to improve the safety of health care in this country.

In fact, the IOM Committee recommended nothing less than a 50 percent reduction in medical errors over the five years that followed its report. Moreover, the Medicare Payment Advisory Commission (MEDPAC) has recommended that Medicare set up goals and payment schemes to improve patient safety at hospitals for Medicare patients. While hospital mortality for Medicare patients declined between 1995 and 2002, MEDPAC has been concerned with the increase in patient safety problems for Medicare patients during the same period.[3] Variations in the quality of care received by Medicare beneficiaries have been documented recently in two additional studies.[4, 5] Such recommended reductions in patient safety errors will require large financial investments in monitoring systems, training programs, systems redesigns, and additional staffing. This presents a dilemma, since many hospitals are already distressed financially as a result of the steep price discounts afforded to managed care plans and the Medicare payment cuts implemented by the Balance Budget Act of 1997. Although the 1999 Balanced Budget Refinement Act (BBRA) generally increased payments to providers, the reduction in annual hospital payment updates for prospective payment system hospitals was not corrected by the BBRA provisions. Thus, some hospitals may find it difficult to make major financial investments aimed at improved patient safety. In fact, the hospital market is now stratified between the "have" and "have not" hospitals, according to financial analysts interviewed for Medicare's 2003 market update.[6] In this study, for example, we found that 25 percent of Florida Medicare FFS patients had major surgeries at the financially distressed "have-not" hospitals with average profits of 8 percent during 1996–99. Conversely, another 25 percent of the same Florida Medicare patient group had major surgeries at the more affluent "have" hospitals, which showed average profits of 17 percent. Such financial disparities may eventually lead to disparities in patient safety for Medicare beneficiaries. We will attempt in this paper to answer the critical question: What type of an association exists between hospital operating margins (i.e., profits) and patient safety for Medicare beneficiaries?

We are aware of just one recent study that addresses this question in terms of mortality, but not in terms of general patient safety. Shen (2003) examined the effect of financial pressures on patient outcomes and found that financial pressures adversely affect patient outcomes.[7] That study used data from an earlier period (1985–94), however, and the scope is limited to death following treatment for acute myocardial infarction. To get a better picture of patient safety, we examined a broad spectrum of patient safety measures relevant to all major surgeries: surgery-related patient safety events, nursing-related patient safety events, death rates for all patients, and failure to rescue a patient following a potentially preventable complication. Among Medicare FFS surgery patients during the four year period from 1996–99, we found that these patient safety

events were 13 percent to 26 percent more likely to occur at financially distressed hospitals (those with negative profit margins), than at highly profitable hospitals (those with more than a 10 percent profit margin).

Method

Hospital data

Our primary source of data was the Healthcare Cost and Utilization Project (HCUP) State Inpatient Database for Florida, which included all inpatient discharges for all general acute-care hospitals. We focused on all elderly (age >64 years) Medicare FFS major surgery discharges from all general acute care Florida hospitals from 1996–99. As a result, our sample consisted of 373,814 elderly Medicare FFS major surgery hospitalizations over the 4-year period in 188 hospitals.

The financial hospital characteristics were obtained from the audited annual cost reports that each Florida hospital submitted to the Florida Agency for Health Care Administration from 1995–98. From these cost reports we calculated each hospital's operating margin. Also known as the profit margin, the operating margin is equal to the ratio of the hospital's net operating profits to the hospital's net operating revenues. Table 1 shows the variation in hospital operating margins across hospitals by year. All other hospital characteristics were obtained from the American Hospital Association's Annual Survey 1996–99. The descriptive statistics for these hospital characteristics are included in Table 3.

Patient safety indicators

We considered four patient safety events measures: surgery-related patient safety events, nursing-related patient safety events, death, and failure to rescue (death following a surgical complication). To do this, we use one of the most up-to-date algorithms that identifies patient safety problems in administrative discharge data: the Patient Safety Indicator (PSI) Module of the Agency for Health Care Research and Quality (AHRQ) Quality Indicators, released in 2003 and available at www.qualityindicators.ahrq.gov/psi_download.htm. The algorithm flags patient safety events based on the International Classification of Disease, Clinical Modification, (ICD-9-CM) codes found in the diagnosis and procedure variables for each discharge. The selection criteria for "major surgery" also are described in the PSI algorithm.

The PSI algorithm was developed by the UCSF–Stanford Evidence-based Practice Center (EPC), in collaboration with the University of California at Davis, and was funded by AHRQ. The EPC process started with a literature review and personal communications with researchers and vendors in the field. Next, the EPC had expert coders identify the 200+ ICD-9-CM codes that clearly flagged complications. Within this set of 200 codes, the EPC then examined 63 nonobstetric iatrogenic complication and patient safety indicators found in the literature (The PSI also features mortality indicators for low-volume procedures

and obstetric complication indicators that are not discussed in this paper). This literature included, among others, the Complications Screening Program (CSP) developed by Iezzoni, et al (1994), the Quality Indicators (QI) developed by Ball, et al (1998) for HCUP-3, the patient safety indicators developed by Miller, et al (2001), and the Outcomes Potentially Sensitive to Nursing (OPSN) studied by Needleman, et al (2002).[8–11] The EPC selected 14 of these 63 indicators using (1) indicator validity results from the literature; (2) empirical analyses of the precision and reliability of the candidate PSIs; and (3) reviews from 11 clinical panels on the potential indicators. These 14 patient safety indicators are used to identify complications that are highly preventable. The clinical panels, in particular, found that 5 of the 14 indicators could themselves be described as medical errors. These five adverse events are indicated with an asterisk in Table 5. More information on the PSIs can be found at www.qualityindicators.ahrq.gov, as well as in Romano et al.[13] and in Zhan and Miller.[14]

Adverse patient safety events

We constructed three measures of patient safety events, based on the PSIs described above: surgery-related patient safety events, nursing-related patient safety events, and failure to rescue (death following a surgical complication). A fourth measure of patient safety used in this study is death during a hospitalization for major surgery.

To examine whether hospital finances have differential effects on surgery-related and nursing-related patient outcomes, we separated the PSIs into two groups. Surgery-related patient safety events were comprised of 12 of the 14 PSIs related to the actual surgery, rather than the postoperative nursing care (see Table 5). Nursing-related patient safety events include hip fractures and decubitus ulcers (the remaining 2 of the 14 PSIs), as well as aspiration pneumonia, atelectasis (i.e., iatrogenic lung collapse), and urinary tract infections, which have been used in the nursing literature.[11, 15, 16, 17]

Failure to rescue is defined as death occurring after a complication that was potentially preventable.[11, 16, 18] That is, the provider is considered to have failed to rescue the patient from a potentially preventable complication if the patient dies. For failure to rescue, we considered a total of 22 complications. These included the 14 highly preventable PSIs as well as 8 additional surgical complications that the EPC identified as potentially preventable complications (page 70 of McDonald, et al).[12] These eight complications include aspiration pneumonia (listed under the nursing-related patient safety events) and the seven additional indicators listed in the Appendix under failure to rescue.

Statistical methods

The unit of analysis is a major surgery discharge by a Medicare FFS patient**.** We consider each of the four measures of patient safety events (surgery-related patient safety events, nursing-related patient safety events, any death, and failure to rescue) in separate logistic multivariate regressions at the discharge level, using the following specification:

$$PSE_{iht} = \beta_1 OM_{ht-1} + \beta_2 X_{iht} + \beta_3 HOSP_{ht} + \gamma_{HSA} + \delta_t + \varepsilon_{iht}$$

where the dependent variable, PSE_{iht}, is a binary indicator of whether patient *i* has an adverse patient safety event at hospital *h*, during year *t.* For surgery-related patient safety events, PSE_{iht} is equal to 1 if patient *i* has at least 1 of the 12 surgery-related patient safety events during the hospitalization, and is equal to 0 if patient *i* does not suffer any surgery-related patient safety events. Similarly, PSE_{iht} is equal to 1 if patient *i* has at least 1 of the 5 nursing-related patient safety events during the hospitalization, and is equal to 0 if patient *i* does not suffer any nursing-related patient safety events. For failure to rescue, the estimate is restricted to the sub-sample of major surgery discharges that incurred any 1 of the 22 potentially preventable complications. For failure to rescue and any patient death regressions, PSE_{iht} is equal to 1 if patient *i* dies during the hospitalization, and is equal to 0 if patient *i* is discharged alive.

The key independent variable is OM_{ht-1}, which is a categorical variable based on the financial operating margin for hospital *h* in year *t-1*. Since there is generally a time lag between a hospital's financial problems and subsequent changes that may affect patient outcomes (such as staffing changes, quality control program adoption, etc.), we lag margin by 1 year. The hospital-level financial indicators, OM_{ht-1}, are constructed separately for each year from 1996–99. We divide the hospital-year observations into four profit categories: less than 0, 0 to 5 percent, 5 to 10 percent, and greater than 10 percent. These categories correspond very closely to the patient quartiles of the data and enable us to compare hospitals with losses (e.g., financially distressed hospitals) to those hospitals with positive margins.

X_{iht} is a vector of controls for the demographic and clinical characteristics of patient *i*, at hospital *h*, in year *t.* These include the patient's age (nine age groups); race and ethnicity; gender; an indicator for a transfer admission; an indicator for an emergency room admission; and the median household income for the patient's ZIP code. To control for case mix, we used indicators for 30 chronic conditions that were developed by Elixhauser et al.[19] in the AHRQ Comorbidity Software and were updated by the Stanford–UCSF Evidence-based Practice Center (EPC). The comorbidity software is included in the PSI module. Since the PSI algorithm uses the procedure and diagnostic codes from discharge abstracts to identify potentially preventable complications that occur during the hospitalization, it is important to use case-mix measures that differentiate between comorbidities present at the time of admission and codes that identify complications that occur during the hospitalization. The AHRQ Comorbidity Software has been updated by the Stanford–UCSF EPC specifically for this purpose and therefore was used in this analysis. In addition, we control for the Major Diagnostic Category of each patient discharge.

$HOSP_{ht}$ is a vector of controls for hospital *h*, in year *t*. These hospital characteristics include an indicator for teaching hospitals, hospital ownership dummies (the reference group is state and local government hospitals), as well as an indicator for large hospitals (large is defined as 200 or more beds).

We also include fixed-effects for Health Service Areas (HSA), γ_{HSA}, to control for time-invariant, unobservable characteristics of markets that may be correlated with both patient outcomes and hospital operating margins within markets. The models include 18 dummy variables for HSAs. Since we pool data from multiple years, year-fixed effects, δt, are included to control for statewide changes in average patient safety event rates over time (1996 is the reference year). ε_{iht} is the random error term. Finally, the standard errors are estimated using the Huber/White sandwich estimator to control for heteroskedasticity and the errors are corrected for clustering at the hospital-year.

One potential concern with pooling the 12 patient safety indicators is that high-profit hospitals and low-profit hospitals might have completely different mixes of the 12 patient safety indicators. Pooling all surgery-related patient safety indicators would not capture this difference in mix across hospitals. To test against this possibility, we compared the distribution of patient safety events between the highest profit hospital quartile and the lowest profit hospital quartile. We found that the distribution of patient safety events across the 12 types of surgery-related patient safety events was statistically the same for the highest profit hospital quartile, as that of the lowest profit hospital quartile. In other words, hospitals on average differ only in the overall frequency of patient safety problems, and not in the mix of patient safety events types. Thus, pooling does not distort our comparison of hospitals, and helps to improve the statistical precision of our estimates.

Results

Table 1 represents the distribution of operating margins for the hospitals in our sample. The top row shows the operating margins at the 25th percentile by year. The same row indicates that one-quarter of the hospitals had profit margins less than -1.34 percent (in other words, losses greater than 1.34 percent) during 1996. By 1999, one-quarter of the hospitals in the sample had profit margins less than -5.98 percent (alternatively, losses greater than 5.98 percent).

Table 1. Operating margins for study sample of Florida hospitals[a]

Lagged operating margin:	1996	1997	1998	1999
Lower quartile	-1.34%	-1.29%	-2.20%	-5.98%
Median	3.42%	5.86%	3.51%	3.12%
Upper quartile	10.30%	11.65%	9.60%	9.22%
Total number of hospitals:	184	182	172	169

[a] Margin = (operating revenue -operating costs) / (operating revenue).
Lagged margin is margin lagged by 1 year.

The second row shows that the median profit margin was 3.42 percent for 1996, which rose to 5.86 percent for 1997, and declined to 3.12 percent for 1999. The third row shows that the hospitals in the highest profit quartile remained

highly profitable through the 4-year study period. The operating margin at the 75th percentile was 10.30 percent for 1996, and 9.22 percent for 1999. In summary, profit margins declined systematically for the most part from 1997–99, but the declines were much more severe among hospitals in the lowest profit quartile.

In Table 2, we have presented the rate of patient safety events by level of hospital operating margin. As described previously, hospital-year observations are divided into four profit categories: less than 0 percent, 0 percent to 5 percent, 5 percent to 10 percent, and greater than 10 percent. These categories correspond very closely to the patient quartiles of the data and enable us to compare hospitals with losses (i.e., financially distressed hospitals) to hospitals with positive margins. We refer to hospitals with 10 percent or higher margins as "highly profitable" hospitals. The first column in Table 2 shows that over the 4-year period from 1996 to 1999, there were 182 hospital-years with operating margins higher than 10 percent and 218 hospital-years with operating margin losses. Table 2 also reveals that for each of the four patient safety events considered, the rates of occurrence were highest among those hospitals with negative operating margins (i.e., hospitals that lost money).

Table 2. Unadjusted rates of patient safety events, 1996–99

Lagged operating margin:	Number of hospitals	Surgery-related patient safety events	Nursing-related patient safety events	Death	Failure to rescue
Greater than 10%	182	2.3%	7.6%	2.6%	11.5%
5% to 10%	144	2.4%	7.8%	2.5%	10.5%
0% to 5%	163	2.5%	7.9%	2.6%	11.1%
Less than 0%	218	2.7%	8.3%	2.8%	12.1%

It is important to note that there is variation in the financial performance of hospitals over the course of the study period. Specifically, 71 percent of hospitals moved from one margin category to another in at least one year. In fact, 43 percent of the hospitals moved from one category to another in at least 2 of the 3 years. Only 29 percent of the hospitals remained in the same margin category throughout the 4 years of the study.

Table 3 presents the descriptive statistics on the hospital and patient characteristics in our sample. In the analysis, the unit of observation is a major surgery discharge.

Table 3. Descriptive statistics

Variables	**Means**
Rate of Surgery-Related Patient Safety Events	2.5%
Rate of Nursing-Related Patient Safety Events	7.9%
Death Rate	2.6%
Rate of Failure to Rescue	11.3%
Hospital Characteristics:	
Lagged Operating Margin	0.056
Teaching Hospital	0.150
Public	0.127
Not-for-Profit	0.523
For-Profit	0.350
Bedsize	393
Patient Characteristics:	
Age	75.8
Female	0.549
White	0.903
Black	0.032
Hispanic	0.043
Other non-white	0.022
Median Household Income($)	34,203
Transfer Admission	0.025
Emergency Room Admission	0.190
Patient Chronic Conditions:	
Congestive Heart Failure	0.064
Arrhythmias	0.153
Valvular Disease	0.055
Pulmonary Circular Disease	0.004
Peripheral Vascular Disease	0.056
Hypertension	0.451
Paralysis	0.014
Other Neurological Disorders	0.047
Chronic Pulmonary Disease	0.172
Diabetes	0.133
Diabetes with Chronic Complications	0.017
Hypothyroidism	0.083
Renal Failure	0.019

Table 3. Descriptive statistics, cont.

Variables	Means
Patient Chronic Conditions, cont.:	
Liver Disease	0.007
Peptic Ulcer Disease X Bleeding	0.010
AIDS	0.00004
Lymphoma	0.005
Metastatic Cancer	0.035
Solid Tumor w/out Metastasis	0.021
Rheumatoid Arthritis Coolagen Vas	0.026
Coagulopathy	0.027
Obesity	0.013
Weight Loss	0.121
Fluid and Electrolyte Disorders	0.016
Chronic Blood Loss Anemia	0.070
Deficiency Anemias	0.008
Alcohol Abuse	0.001
Psychoses	0.009
Depression	0.024
Number of Observations:	373,814

During the study period, 2.5 percent of the 373,814 major surgery patients had at least one of the surgery-related patient safety events, while 7.9 percent of the surgery patients had at least one of the nursing-related patient safety events. Overall, 2.6 percent of the patients represented in the sample died during hospitalization. Among all major surgery patients, 6.8 percent had a potentially preventable complication. The rate of failure to rescue, the in-hospital death rate for those patients that suffer potentially preventable complications, was 11.3 percent (25,392 major surgery patients had potentially preventable complications). Fifteen percent of major surgery hospitalizations took place at teaching hospitals. Fifty-two percent of major surgery hospitalizations occurred at not-for-profit hospitals, while 35 percent occurred at for-profit hospitals and only 13 percent took place at public hospitals.

In Table 4, we present the results from the logistic regressions described above. We construct indicator variables for four ranges of hospital margins. The omitted category includes highly profitable hospitals with margins of more than 10 percent. The lowest category includes those hospitals with losses (negative margins).

In column 1, we see that major surgery patients at the financially distressed hospitals are 13.7 percent more likely to experience a surgery-related patient

safety event than are patients at highly profitable hospitals with margins exceeding 10 percent ($P = 0.034$). The probability of a patient safety event at hospitals with margins ranging from 0 percent to 5 percent, and from 5 percent to 10 percent, is not significantly different from that of highly profitable hospitals with margins exceeding 10 percent.

Table 4. Estimated odds ratio of a patient safety event[a]

Independent variables	Surgery-Related Patient Safety Event	Nursing-Related Patient Safety Events	Death	Failure to Rescue
Lagged Operating Margin:				
Greater than 10%	–	–	–	–
5% to 10%	0.999 (0.059)	1.171*** (0.049)	1.113** (0.057)	1.073 (0.106)
0% to 5%	1.087 (0.065)	1.175*** (0.055)	1.147*** (0.059)	1.144 (0.112)
Less than 0%	1.137** (0.068)	1.183*** (0.062)	1.241*** (0.073)	1.260** (0.131)
Other Hospital Characteristics:				
Teaching Hospital	1.165*** (0.068)	1.087 (0.064)	1.178*** (0.068)	0.992 (0.100)
Not-for-Profit	0.955 (0.064)	0.975 (0.054)	0.805*** (0.048)	0.799** (0.083)
For-Profit	0.900 (0.066)	1.1073 (0.059)	0.928 (0.059)	0.911 (0.105)
Large	0.910** (0.038)	0.928** (0.030)	1.017 (0.037)	0.961 (0.070)
Patient Characteristics:				
Female	1.183*** (0.027)	1.502*** (0.025)	0.967 (0.025)	1.022 (0.046)
Black	1.240*** (0.071)	1.446*** (0.049)	1.083 (0.065)	1.264** (0.135)
Hispanic	0.938 (0.054)	1.168*** (0.050)	1.103 (0.068)	1.044 (0.135)
Other non-white	1.048 (0.083)	1.099** (0.050)	1.240*** (0.091)	1.278** (0.151)
Ln (Median household income)	0.966 (0.047)	1.064* (0.039)	0.891* (0.051)	0.866 (0.089)
Transfer Admission	0.833*** (0.059)	1.369*** (0.066)	1.857*** (0.107)	1.176** (0.093)
Emergency Room Admission	0.665*** (0.025)	1.410*** (0.029)	4.486*** (0.147)	1.797*** (0.100)

[a] Dependent variable is patient safety indicators. Robust standard errors corrected for clustering at the hospital are in parenthesis. The variable Large refers to any hospital with 200+ beds. Not shown are 9 dummy variables for age groups, 17 MDC dummies, and 18 HSA dummies.

*** Significant at $P \leq 0.01$.

** Significant at $P \leq 0.05$.

* Significant at $P \leq 0.1$.

Column 2 of Table 4 reveals that as hospital operating margins decline, the probability of a nursing-related patient safety event increases. In particular, patients treated at financially distressed hospitals have 18.3 percent higher odds of having a nursing-related patient safety event than patients treated at highly profitable hospitals ($P = 0.001$). Column 3 shows that as hospital operating margins decline, the probability of patient death increases. The probability of an in-hospital death is 24.1 percent higher among patients treated at financially distressed hospitals, than among those patients treated at highly profitable hospitals ($P < 0.001$). In column 4, the sample is restricted to those surgeries that involved a potentially preventable complication (N = 25,392; 6.8 percent of all surgeries). Among patients with complications, those treated at financially distressed hospitals have 26 percent higher odds of not being rescued and of dying than patients at highly profitable hospitals ($P = 0.027$).

In Table 4 we also see that patients treated at teaching hospitals have a significantly higher risk of a surgery-related patient safety event and of death. This is consistent with the fact that teaching hospitals often perform new, complex, and high-risk surgeries. Next, Table 4 shows that patients treated at large hospitals (defined as hospitals with more than 200 beds) have a lower risk of a surgery-related or nursing-related patient safety event. We also found that not-for-profit hospitals have a lower risk of death and failure to rescue than do public hospitals. We found no difference, however, between public, for-profit, and not-for-profit hospitals, in terms of surgery-related and nursing-related safety events. Thus, our overall findings suggest that it is the hospital's financial circumstances and not the form of ownership that has the larger correlation with patient safety.

Table 4 further indicates that the probability of adverse patient safety events vary by gender, race, and ethnicity. We found that women are significantly more likely to have surgery-related patient safety events (18 percent greater likelihood) and nursing-related adverse patient safety events (50 percent greater probability). Blacks are more likely than whites to have surgery-related patient safety events (24 percent greater likelihood), nursing-related patient safety events (45 percent greater probability), as well as failure to rescue (26.4 percent higher odds). Similarly, Hispanics are significantly more likely than whites to a have a nursing-related problem (17 percent greater likelihood). Other non-Hispanic racial minorities (e.g., Asians) are significantly more likely to die (24 percent greater probability) or experience a failure to rescue than are whites (28 percent greater likelihood). Finally, the year dummies in Table 4 show that the probability of nursing-related patient safety events declined while the probability of death increased during the study period. Additional variables absent from Table 4 but included in the models are 9 dummy variables for age groups, 17 dummies for Major Diagnostic Categories, and 18 indicators for Health Service Areas.

Discussion

We found that financially distressed hospitals have worse patient safety rates than highly profitable hospitals across all four measures of patient safety. One

would expect the higher rates of nursing-related patient safety events at distressed hospitals to be related to higher patient-to-nurse staffing ratios. In fact, previous studies have indicated that reductions in nursing staff are associated with increased rates of complications and deaths.[11, 15, 16, 17] Needleman et al. found that among surgical patients, a lower "proportion of care provided by registered nurses" was associated with higher rates of urinary tract infection and "failure to rescue" incidents following a complication[11] Kovner et al. found that lower rates of registered nurse hours per adjusted inpatient day were associated with higher rates of pneumonia for routine and emergency patient admissions.[17]

If hospitals were more likely to respond to financial problems with using cost-cutting measures related to nursing care, rather than those related to physician staff (and/or medical technology investments), we would find that financially distressed hospitals have higher rates of nursing-related patient safety events, but not necessarily higher rates of surgery-related patient safety events. The finding that financially distressed hospitals have higher rates of surgery-related patient safety events (complications due to surgery-related care rather, than nursing-related care) suggests that cuts in nursing staff may not be the only mechanism by which hospital finances affect patient outcomes. Financial pressures may lead to changes in hospital operations (e.g., lower physician staffing levels, or delays in adopting costly medical technology) that affect the quality of care provided by surgeons and anesthesiologists, as well as nurses. Future research should examine the exact mechanism by which financial pressures impact patient safety systemwide. Recall that these surgery-related patient safety events are based on just 12 measurable patient safety indicators. There may be many more preventable patient safety events (as well as near misses) that are occurring at the same time, but that are not measurable in our data. Also, due to data limitations, our patient safety measures do not include medication errors.

We also found that the probability of having adverse patient safety events varies by gender and race. Our results show that women are significantly more likely to have surgery-and nursing-related adverse patient safety events; that blacks are more likely to have surgery-related patient safety events and nursing-related patient safety events, as well as failure to rescue; that Hispanics are more likely to a have a nursing-related problem; and that other non-Hispanic racial minorities are significantly more likely to die or experience failure to rescue than are whites. Other researchers have found similar gender disparities in health care. One recent study, for example, found that women who have contracted the HIV virus are significantly less likely to be prescribed newer, more costly, but more effective medications compared to men.[20] The race and ethnicity results may be explained in part by differences in unobserved severity. Another potential explanation is the segmentation of patients across different quality providers (e.g., high costs may prevent low income patients from obtaining care from higher quality hospitals and/or physicians). More research is needed to identify the sources of disparity in patient safety outcomes across gender and race.

It should be noted that there are several potential limitations of our study. First, lower rates of patient safety events at highly profitable hospitals may be

driven, in part, by the ability of the hospitals to attract healthier patients, while avoiding severely ill patients. In order to avoid this selection effect, we focused solely on fee-for-service Medicare patients who were not restricted in their choice of hospitals. There may still be selection bias, however, if some hospitals choose to locate in areas with a relatively young and healthy elderly population.[21] We believe we have mitigated this potential selection bias by controlling for an exhaustive list of 30 comorbidities that capture the patient's severity. Second, our results from Florida may not extend to the rest of the country. Florida has a higher proportion of for-profit hospitals—more than 30 percent—compared with less than 10 percent for the nation as a whole. We do not expect this to be a problem, however, since we did not identify a "for-profit effect" on patient safety outcomes in our study. Also, Florida has a higher proportion of Medicare patients than the rest of the nation. Future research should examine the impact of hospital finances on patient outcomes at the national level.

Conclusion

Our results provide insight for those wishing to implement quality-based payments as rewards for quality improvement, as recommended in the 2001 Institute of Medicine report, *Crossing the Quality Chasm*.[22] Our results suggest that the magnitude of quality improvement may be large, if financial incentives are provided. For Medicare fee-for-service surgery patients, we found that our four broad measures of patient safety events are 13 percent to 26 percent more likely to occur at financially distressed hospitals with negative profit margins, than at highly profitable hospitals with profit margins exceeding 10 percent. Thus, a quality-based payment structure that includes a bonus for quality improvement might possibly induce the desired quality improvements in "have-not" hospitals. While these bonuses may appear expensive in the short-term, the long-term reduction in errors may offset the expense of these added incentives. In fact, the cost savings resulting from reduced errors could be as high as $30 billion annually.[2] Future research should strive to examine the effect of quality-based payments on patient safety. Alternatively, policymakers may consider steering patients to "higher quality" hospitals. Finally, the finding that financially distressed hospitals have more adverse patient safety events suggests that any reductions in hospital payments for Medicare beneficiaries and Medicaid recipients should be carefully designed and managed.

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